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Nutrient composition of value added eggless muffins incorporating full fat rice bran, mixed nuts and sesame seeds

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Abstract
The present investigation was conducted to evaluate the nutrient composition of developed value added eggless muffins incorporating full fat rice bran, mixed nuts and sesame seed. Value added Type I and Type II eggless muffins contained full fat rice bran at the levels of 10 and 20 per cent, respectively but both contained 10 per cent mixed nuts and sesame seeds. The control had 10 per cent mixed nuts and sesame seeds but did not contain rice bran. It was observed that value addition with rice bran improved the nutritional value of eggless muffins in terms of ash, fat, protein, fibre as well as total minerals. Crude fat content increased from 19.10 to 22.90 g/100g, crude protein increased from 6.90 to 7.70 g/100g while crude fibre increased from 0.94 g/100g in control to 2.98 g/100g in Type II eggless muffins. Dietary fiber content includes soluble, insoluble and total dietary fiber. Soluble dietary fiber content increased from 0.54 to 1.15 g/100g, insoluble dietary fiber content increased from 1.56 to 5.38 g/100g and total dietary fiber increased from 2.10 to 6.54 g/100g. Protein digestibility (*in vitro*) was decreased when the level of full fat rice bran was increased in the eggless muffins. Value addition also resulted in improvement in mineral profile of the products. Calcium, magnesium, iron, potassium and magnesium, respectively ranged up to 100.90, 355.50, 8.02, 376.60 and 237.50 mg/100g. Such developed products can be very useful in combating the micronutrients deficiency problem in population of all age groups.

Keywords: Rice bran, value addition, nutritional composition, fiber, protein digestibility (*in vitro*) and total minerals.

Introduction
Bakery products once considered as a sick man's diet have now become essential food items of vast majority of population in India. They are becoming popular even in places where rice has been the staple food. The contributing factors for the popularity of bakery products are urbanization resulting in increased demand for ready to eat convenient products, availability at reasonable cost, greater nutritional quality, availability of varieties with different textural and taste profiles and better taste. The bakery products such as breads and muffins have become popular among all cross section of population irrespective of age group and economic conditions (Saranraj *et al*., 2012 [1]).

A variety of wheat flour substitutes such as rice bran can be tried in bread and muffins formulation. Rice bran, the brown outer layer of rice kernel is mainly composed of pericarp, aleurone/sub-aleurone layers and germ accounting for approximately 10% of the weight of the rice grain (Justo *et al.,* 2013 [2]). Currently, it is discarded as a waste product during the process of rice milling in India. However, it is an excellent source of total dietary fiber ranging from 20 - 51%. It is also a good source of proteins, lipids, vitamins and minerals. Chemically, it contains 11 - 17% protein, 11 - 18% fat, 10% fiber, 9% ash and 45% - 65% nitrogen free extract (NFE). It is a rich source of B-vitamins and minerals such as potassium, calcium, magnesium and iron (Godber *et al.,* 2009 [3]).

Rice bran is composed of both lipophilic antioxidants (tocopherols, tocotrienols and γ-oryzanol) and phenolic compounds. These substances protect against chronic diseases of the cardiovascular system and help to quench the free radicals and anti-cancer effects (Rondanelli *et al.,* 2011[4]). Possible positive health effects of rice bran are including phenolic compounds to improve the lipid profile and blood glucose level and to inhibit the growth of human breast and proliferation of cancer cells. Hence, rice bran has potential health benefits in the prevention of diseases such as cancer, kidney stones, heart disease and hyperlipidaemia. It also helps in lowering the blood pressure; improving cognition, blood glucose and cholesterol levels. It also has anticancer mechanism i.e. dietary fiber, Phytic acid and phytosterols (Butsat *et al.,* 2010 [5]).

Above mentioned health and nutritional benefits, there is a scope for supplementation of wheat flour with full fat rice bran or its defatted portion not only to uplift the nutritional profile of cereal based food products with special reference to protein, lysine and dietary fiber contents but also to be used as an additive to improve the storage stability in food due to its natural antioxidant properties. The above described nutritional and functional properties of rice bran can be suitable for incorporation in the baked products, namely cookies, muffins, breads, and crackers so as to substitute some part of refined wheat flour. The addition of rice bran into the refined wheat flour can further increase the protein quality and dietary fiber contents in muffins (Sharif *et al*., 2009 [6]).

Materials and methods

Present study was carried out in Department of Foods and Nutrition, I.C. College of Home science, Chaudhary Charan Singh Haryana Agricultural University, Hisar. Rice bran was procured in a single lot from the rice mill located at Yamunanagar. For the preparation of eggless muffins the required ingredients namely, refined flour, butter, condensed milk, sesame seeds, almonds, cashew nuts, ammonia and baking powder were purchased in a single lot from the local market of Hisar.

Nutritional evaluation of value added eggless muffins incorporating full fat rice bran

Moisture, ash, crude fat, crude protein and crude fiber were estimated by employing the standard methods of analysis AOAC, 2012[7]. The total carbohydrate was calculated by the difference method. Total carbohydrate (%) = 100 – [crude protein (%) + crude fat (%) + crude fiber (%) + total ash (%)]. Total, soluble and insoluble dietary fiber constituents were determined by the enzymatic method given by Furda, 1981[8]. Total calcium, iron, zinc, potassium and magnesium in acid digested samples were determined by Atomic Absorption Spectrophotometer according to the method of Lindsey and Norwell 1969[9]. Phosphorus was determined colorimetrically by the method of Chen *et al*., 1956 [10]. Ionizable iron in the samples was extracted according to the procedure of (Rao and Prabhavati 1978[11]). *In vitro* protein digestibility was carried out by using the modified method of (Mertz *et al.* 1983[12]).

Results and Discussion

Fig 1: Value added eggless muffins

Value added Type I and Type II eggless muffins contained full fat rice bran at the levels of 10 and 20 per cent, respectively but both contained 10 per cent mixed nuts and sesame seeds. The control had 10 per cent mixed nuts and sesame seeds but did not contain rice bran.

Control eggless muffins had moisture 2.23, crude protein 6.90, crude fat 19.10, crude fibre 0.94, ash 1.10 and total carbohydrates 71.96 per cent. Upon supplementation of 10 and 20 per cent of full fat rice bran in Type I and Type II eggless muffins, contents of moisture, crude protein, crude fat, crude fiber, ash and total carbohydrate were 3.20, 3.60; 7.50, 7.70; 21.10, 22.90; 2.04, 2.98; 2.10, 3.20 and 67.26, 63.60 per cent, respectively. It was found that moisture, protein, crude fat, crude fiber and ash contents increased significantly but total carbohydrates were decreased significantly over the control in Type II eggless muffins containing 20 per cent full fat rice bran. The addition of defatted rice bran and flaxseeds improved the proximate composition, dietary fiber contents of breads (Ajmal *et al.* 2006 [13]). Similar findings were supported by (Ameh *et al.* 2013 [14]). Moisture, crude protein, crude fat, crude fiber and ash in breads prepared from the composite flour of refined flour and rice bran were 21.07 to 23.67 per cent, 12.04-13.14 per cent, 1.57-3.77 per cent, 1.76-2.91 per cent and 1.46-2.41 per cent, respectively.

Table 1: Proximate composition of value added eggless muffins incorporating full fat rice bran (10 and 20 %) and mixed nuts and sesame seeds (@ 10 %) and (%, on dry weight basis)

Levels of full fat rice bran in eggless muffins containing mixed nuts and sesame seeds	Moisture	Crude protein	Crude fat	Crude fiber	Ash	Total carbohydrates
Control (90:10:: RF: MN& SS)	2.23±0.07	6.90±0.12	19.10±0.06	0.94±0.02	1.10±0.06	71.96±0.10
Type I (80:10:10::RF:RB:MN& SS)	3.20±0.09	7.50±0.11	21.10±0.16	2.04±0.03	2.10±0.08	67.26±0.12
Type II (70:20:10: RF:RB: MN& SS)	3.60±0.12	7.70±0.13	22.90±0.13	2.98±0.04	3.20±0.09	63.60±0.16
CD (P=0.05)	0.14	0.20	0.16	0.05	0.17	0.25

Values are mean ± SE of three independent determinations. RF: Refined flour, RB: Rice bran MN&SS: Mixed nuts and sesame seeds

Table 2 reflects that the total dietary fiber contents of control, value added Type I and Type II eggless muffins were 2.10, 4.20 and 6.50 g/100g, respectively; a significant (P<0.05) difference was observed in their total dietary fiber contents. Highest amount of total dietary fiber content was present in Type II eggless muffins incorporating 20 per cent full fat rice bran and mixed nuts and sesame seeds and the lowest in control. Type II eggless muffins had maximum (1.15 g/100g) value of soluble dietary fiber content too while and control eggless muffins had the lowest (0.54 g/100g). Insoluble dietary fiber content of control (1.56 g/100g), and Type I (3.25 g/100g), Type II eggless muffins (5.38 g/100g) showed significant (P<0.05) differences for their insoluble dietary fiber contents also. (Krishnan *et al*., 1998 [15]) studied the effects of oat bran supplementation (10-15 %) in muffins. Dietary fiber and protein contents increased significantly with oat bran supplementation up to 10 per cent. Dietary fiber contents of muffins improved due to the supplementation with

flaxseed and rice bran in wheat flour. The flaxseed was rich in insoluble, soluble and total dietary fibre, and the addition of flaxseeds resulted in the improvement of dietary fiber contents of products in which it was present. Similar findings were supported by Ameh *et al.* (2013 [16]).

Table 2: Dietary fiber content of value added eggless muffins incorporating full fat rice bran (10 and 20 %) and mixed nuts and sesame seeds (@ 10 %) (g/100g, on dry weight basis)

Levels of full fat rice bran in eggless muffins containing mixed nuts and sesame seeds	Total dietary fiber	Insoluble dietary fiber	Soluble dietary fiber
Control (90:10::RF: MN& SS)	2.10±0.06	1.56±0.02	0.54±0.04
Type I (80:10:10::RF:RB:MN& SS)	4.20±0.08	3.25±0.04	0.94±0.05
Type II (70:20:10::RF:RB: MN& SS)	6.54±0.10	5.38±0.07	1.15±0.08
CD (P=0.05)	0.18	0.09	0.10

Values are mean ± SE of three independent determinations. RF: Refined flour, RB: Rice bran, MN&SS: Mixed nuts and sesame seeds

The protein digestibility (*in vitro*) of control, value added Type I and Type II eggless muffins incorporating 10 and 20 per cent was full fat rice bran 73.35, 71.90 and 70.80 per cent, respectively (Table 3). Protein digestibility (*in vitro*) was decreased when the level of full fat rice bran was increased in the eggless muffins.

Table 3: Protein digestibility (*in vitro*) of value added eggless muffins incorporating full fat rice bran (10 and 20%) and mixed nuts and sesame seeds (@ 10%) (%, on dry weight basis)

Levels of full fat rice bran in eggless muffins containing mixed nuts and sesame seeds	Protein digestibility (*in vitro*)
Control (90:10::RF: MN& SS)	73.35±0.07
Type I (80:10:10::RF:RB:MN& SS)	71.90±0.04
Type II (70:20:10::RF:RB: MN& SS)	70.80±0.03
CD (P=0.05)	0.09

Values are mean ± SE of three independent determinations. RF: Refined flour, RB: Rice bran, MN&SS: Mixed nuts and sesame seeds

Total calcium contents in control, value added Type I and II eggless muffins were found to be 86.9, 93.9, 100.9 mg/100g, respectively; they had significant (p<0.05) differences in their total calcium contents. But, Type II eggless muffins incorporating 20 per cent full fat rice bran and mixed nuts and sesame seeds had significantly (P<0.05) higher total calcium content than that of control and Type I eggless muffins (Table 4).

Similarly, Type II eggless muffins had 8.02 mg total iron per 100g, which was significantly (P<0.05) higher than that of Type I (5.10 mg/100g) and control (2.20 mg/100g) eggless muffins. Total phosphorus content was significantly (P<0.05) higher in Type II eggless muffins (355.50 mg/100g) followed by Type I (222.20 mg/100g) and control (88.90 mg/100g) eggless muffins. Minimum amount of total phosphorus was observed in control eggless muffins.

Total magnesium contents in control, Type I and Type II eggless muffins were 57.10, 147.30, 237.50 mg/100g, respectively; a significant difference was observed in their total magnesium content. More the amount of full fat rice bran in the muffins, higher was the total magnesium content. Similar was for total potassium content. Type II eggless muffins had 376.60 total potassium per 100 g, which was significantly (P<0.05) higher than that of Type I (233.10 mg/100g) and control (88.90 mg/100g) eggless muffins (Table 4). These finding corroborate with those of (Sairam *et al.* 2011 [17]) who observed increase in dietary fiber and minerals with increasing level of rice bran.

Table 4: Total mineral content of value added eggless muffins incorporating full fat rice bran (10 and 20 %) and mixed nuts and sesame seeds (@ 10 %) and (mg/100g, on dry matter basis)

Levels full fat of rice bran in eggless muffins containing mixed nuts and sesame seeds	Calcium	Phosphorus	Iron	Potassium	Magnesium
Control (90:10::RF: MN& SS)	86.90±0.12	88.90±0.03	2.20±0.03	89.60±0.03	57.10±0.06
Type I (80:10:10::RF:RB:MN& SS)	93.90±0.14	222.20±0.09	5.10±0.06	233.10±0.06	147.30±0.11
Type II (70:20:10::RF:RB: MN& SS)	100.90±0.16	355.50±0.12	8.02±0.05	376.60±0.06	237.50±0.12
CD (P=0.05)	0.24	0.13	0.12	0.17	0.16

Values are mean ± SE of three independent determinations. RF: Refined flour, RB: Rice bran MN&SS: Mixed nuts and sesame seeds

Regarding availability of calcium and iron, significant (p<0.05) differences were found in various types of eggless muffins (Table 5). Type I and Type II eggless muffins had significantly (P<0.05) higher available calcium over the control eggless muffins but per cent calcium availability was significantly (p<0.05) less over the control. Percent availability of iron was observed to be maximum from control (38.18%) and minimum from Type II eggless muffins (23.20%). The amount of available iron was more from Type I and Type II eggless muffins incorporating full fat rice bran but per cent availability of iron was significantly (p<0.05) less when compared to that of control.

Table 5: Availability of calcium and iron of value added eggless muffins incorporating full fat rice bran (10 and 20 %) and mixed nuts and sesame seeds (@ 10%) (mg/100g, on dry weight basis

Levels full fat of rice bran in eggless muffins containing mixed nuts and sesame seeds	Total calcium	Available calcium	Total iron	Available iron
Control (90:10::RF: MN& SS)	86.90±0.12	38.90±0.14 (44.76%)	2.20±0.03	0.83±0.03 (38.18%)
Type I (80:10:10::RF:RB:MN& SS)	93.90±0.14	39.40±0.13 (40.00%)	5.10±0.06	1.30±0.04 (25.89%)
Type II (70:20:10::RF:RB: MN& SS)	100.90±0.16	39.27±0.09 (38.08%)	8.04±0.07	1.86±0.05 (23.20%)
CD (P=0.05)	0.24	0.19	0.12	0.07

Values are mean ± SE of three independent determinations. RF: Refined flour, RB: Rice bran, MN&SS: Mixed nuts and sesame seeds Values in parenthesis indicate per cent availability of the mineral

Conclusion

Incorporation of full fat rice bran significantly ($P \leq 0.05$) improved the nutrient and mineral profile of eggless muffins. Such developed products can be very useful in combating the micronutrients deficiency problem in population of all age groups.

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